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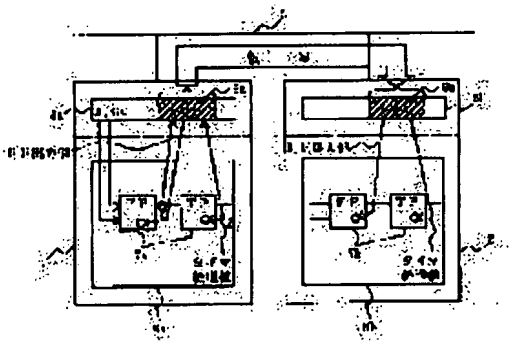
(54) MULTIPLEX SYSTEM FOR CONTROLLER

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a duplex system for a controller in a process control system in order to improve the reliability, continuity and safety of the process control of the system.

SOLUTION: The duplex system consists of a main controller 1 and a standby controller 2 and periodically secures the coincidence of data necessary between both controllers. Then the data necessary for coincidence between the controllers 1 and 2 are previously decided among the input/output data on the arithmetic elements 7a and 7b of the controller 1 and also the internal data used for operations of both elements 7a and 7b. When the data requiring the coincidence between both controllers are calculated by operations in every arithmetic cycle, these calculated data are written in a coincidence data area 9a of a memory 8a of the controller 12 and also transferred into a coincidence data area 9b of a memory 8b of the controller 12 in a coincidence processing cycle.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the multiplex system of the control unit which considers a controller as a doubleness configuration in a process control system.
[0002]
[Description of the Prior Art] Generally, the control unit which makes a large-scale plant a controlled system is considering the controller as the doubleness configuration. This aims at interruption prevention of plant control by forming the standby side controller which switches and performs control, when the main system controller other than the main system controller which performs control becomes impossible of operation. Furthermore, by the doubleness controller, in order to avoid turbulence actuation of a plant, it is necessary to prevent the sudden change of the process I/O signal at the time of a switch. The same operation program is given to both controllers as this cure, and it is made to perform using the same data. Here, there are two of in-house datas used only when performing the I/O signal which the arithmetic element which constitutes an operation program uses as initial value next time at the time of an operation, and the program inside an arithmetic element, such as the timer set point and the gain set point, in the data which need the identification used in case an operation program is performed within both controllers. By the doubleness controller of the conventional process control system, identification of the data in both controllers is attained by transmitting the data which need such identification to a standby side controller from a main system controller. In this case, it is reflected in the program for reception in a standby side controller (receiving side), while a designer performs program design for identification processing, choosing data [need / a designer / the identification within an operation program] and reflecting this selected identification data in the program for transmission in a main system controller (transmitting side), in order to transmit the data which need this identification. By this doubleness controller, it is required to do the activity which chooses the data with which a designer requires identification although identification of the data between both controllers is attained. On the other hand, selection by the designer is omitted and there is an approach identification considers that all of the I / O data of an arithmetic element and its in-house data are required data, and copies them, at the time of a switch of a main system / standby system controller. As for this approach, a standby side controller starts actuation as a main system after termination of a copy. Moreover, the method of operating is indicated by JP,62-187901,A in the doubleness controller of a process control system, carrying out the comparison check of the gap having not occurred in I/O of the arithmetic element which constitutes the operation program between a main system / standby system controller.
[0003]
[Problem(s) to be Solved by the Invention] In the doubleness controller of the conventional process control system, by program design which does the activity which chooses the data with which a designer requires identification, skill of a designer is required, there are many places which the software design quality of a control unit depends on a designer's group human nature, and a problem is in dependability on quality control of a control unit. Moreover, with large-scale-izing of a control unit in recent years, the capacity of an operation program is also in the inclination of expansion, and searching the required data of identification from this immense program has the problem that it is not easy and a design man day increases. Moreover, since the approach of copying all of the I / O data of an arithmetic element and its in-house data at the time of a switch of a main system / standby system controller switches to a main system when a total I / O data and all in-house datas are copied to a standby side controller from a main system side controller, the identification of the data between both controllers takes a duration to it, and a problem is in the continuity of process control. Moreover, by the approach given in an official report, while a doubleness controller synchronizes and operating, it is think that it is satisfactory, but by the controller which started afterwards, when starting another

controller (standby side) the first stage when one side of a doubleness controller has already operate by the main system, and carrying out, since operation initial value differs from the controller under main system actuation, the sudden change of process I/O data will be produce and a problem is in the safety of plant control.
[0004] The purpose of this invention is to offer the multiplex system of a suitable control unit to raise the dependability, continuity, and safety of process control, without being dependent on a designer's level of skill in view of the situation mentioned above in the process control system which has a doubleness controller.
[0005]
[Means for Solving the Problem] In the multiplex system of a control device, the above-mentioned purpose can be attained by imprinting in the memory of a standby system controller at the time of an identification processing period while writing these data in self memory, when the data which need identification are beforehand determined among both controllers out of the in-house data used for the I / O data of the arithmetic element of a main system controller, and the operation of this arithmetic element and said identification computes required data by data processing for every operation period. Moreover, it can attain by preparing the identification data area which a main system controller and a standby system controller swerve in this case, and stores the data which need identification among both controllers in the memory of **. Furthermore, when not performing beyond the time amount that the imprint of the data which need the identification transmitted to a standby system controller from a main system controller set up beforehand Or while the imprint of the data which need the identification transmitted to a standby system controller from a main system controller at the time of initial starting of a controller is not completed Or while the amount of processes of a controlled system is changing, when identification of data is not performed more than over the time amount part which obtains the maximum variation of the amount of processes permissible on the property of a process It can attain by making improper a switch of a main system / standby system controller.
[0006]
[Function] At a main system side, by the standby system side, this invention writes this data in an identification data area, it is only imprinting the data transmitted from a main system side to an identification data area, and identification of the data of both controllers is attained and its dependability improves with improvement in the quality of a control unit in order to determine beforehand the data which need identification between a main system controller and a standby system controller for every control arithmetic element. Moreover, the data which need identification are periodically copied to the identification data area of a main system controller to a standby system controller, and do not have the need for the time amount for carrying out identification of this data at the time of a switch of the main system / standby system of a controller. Therefore, the continuity of the process control at the time of a controller switch improves. Moreover, even if the result of an operation of both controllers of a control operation program corresponds and a switch of a main system / standby system controller occurs at the time of arbitration, process control which change did not occur suddenly in the process I/O of a controller, and was stabilized is performed. Moreover, while the data which need data coincidence have been an inequality among both controllers, in order not to perform a switch of a main system / standby system at the time of a main system / standby system controller switch, it prevents causing turbulence in a plant.
[0007]
[Example] Hereafter, the example of this invention is explained using a drawing. Drawing 1 is the block diagram of the multiplex system of the control unit in which one example of this invention is shown. drawing 1 -- setting -- 1 -- a standby side (system), in a network and 4, a system bus and 5 show a process I/O unit (PI/O), and, as for a main system controller and 2, P shows [a controller and 3] a plant. The main system controller 1 and the standby system controller 2 by which two sets of CPUs perform the operation of a dupe REKUSU method, they realize doubleness, and this multiplex system is connected to the network 3 calculate the process control program same an original operation period respectively. Usually, the main system controller 1 is accessed with PI/O5 through a system bus 4, and performs the input of a process data, and the output of process control data. Since I/O of data with two sets of CPUs to PI/O5 is not made to coincidence, access to PI/O5 is stopped for the standby system controller 2 by the access contention of a system bus 4. By the way, if the main system controller 1 becomes unusual and serves as impossible of operation, a switch of a main system / standby system controller is performed, and the standby system controller 2 will acquire an access privilege with PI/O5, and will perform the input of a process data, and the output of process control data.
[0008] Drawing 2 is a conceptual diagram explaining the data identification in both the controllers of this example. In drawing 2 , both the controllers 1 serve as the control operation programs 6a and 6b constituted by arithmetic elements 7a and 7b from the memory 8a and 8b which formed the identification data areas 9a and 9b out of the work-piece data area. The control operation programs 6a and 6b of both the controllers 1 and 2 perform an operation an operation period original with both controllers. Arithmetic elements 7a and 7b consist of two or more arithmetic elements FF

(flip-flop circuit) which constitute an operation program, and two or more timers (TP), and the information which needs the identification of data is beforehand determined among the operation parameters of a timer setup (in-house data) of the timer TP used for I/O of the arithmetic element FF in a control circuit, and the operation of the arithmetic element at every arithmetic element 7of main system controller 1 a etc. Memory 8a and 8b forms the identification data areas 9a and 9b in memory, and holds the required data of identification among both controllers. In addition, although there was the gain set point etc. as an in-house data which needs identification, it omitted in order to simplify explanation. In this example, processing of the data identification of both controllers is performed as follows. First, for every operation period of the main system controller 1, the arithmetic element FF of the main system controller 1 inputs the FF input data A and B from the work-piece data area in memory 8a of self, and computes the FF output value Y by FF data processing. Since the I/O signal of this arithmetic element FF is decided noting that it is data which need identification among both controllers beforehand, it writes in predetermined identification data area 9a which established the FF output value Y in memory 8a of self among both controllers as data which need identification. Moreover, the timer TP of the main system controller 1 inputs TP input data (last progress value) C of a timer from the work-piece data area in memory 8a of self for every operation period, and computes the timer progress value Z (initial value of a next operation) by data processing. Since the timer set point of this timer TP is decided on the occasion of the operation of an arithmetic element FF noting that identification is required data among both controllers, it is written in predetermined identification data area 9a which established the timer progress value Z in memory 8a of self among both controllers as data which need identification. Next, it writes to identification data area 9a of the main system controller 1, and the ****** FF output value Y and the timer progress value Z are transmitted to predetermined identification data area 9b prepared in memory 8b of the standby system controller 2 through the network 3, and are imprinted. Thus, identification of the data which need identification is performed between both the controllers 1 and 2.

[0009] Here, the detail drawing of the data flow between the arithmetic element and timer by the data identification shown in drawing 3 at drawing 2 , and memory is shown. Calculating [and] the I/O signal used as initial value the next time which is data which need the identification used in case an arithmetic element FF performs an operation program within both controllers here at the time of an operation, Timer TP calculates the timer set point which is data which need identification within both the controllers used only when performing the program inside an arithmetic element. In drawing 3 , the arithmetic element FF 7 of both the controllers 1 and 2 and timer TP7' are one in the control operation programs 6a and 6b constituted from two or more arithmetic elements and a timer, and have the initial value of an operation other than input data and output data as activity data next time, respectively. Memory 8a and 8b consists of identification data area 9a which stores the FF input data A and B, FF output-data Y, TP input data C, the work-piece data area that stores TP output-data Z, the FF output value Y established in this memory, and the timer output value Z. Here, in great numbers, identification data area 9b of the identification data areas 9a and 8b of memory 8a supports the same address so that it may become, and it is taken as the structure copied among both controllers (imprint). In addition, an arrow head shows the sequence of an operation. If it becomes the operation period of the arithmetic element FF 7 in control operation program 6a now, an arithmetic element FF 7 will read FF output-value Y' which is the operation initial value of an operation last time from predetermined FF7 output data area 4002 of identification data area 9a, and will perform data processing while it reads the FF input data A and B from FF7 input data area 4001 in which the input data required for an operation is stored by the predetermined work-piece data area in memory 8a. After this data processing is completed, while the arithmetic element FF 7 by the side of a main system sets the result of an operation to FF output-data Y and stores it in predetermined FF7 output data area 4003 in memory 8a, it is written in predetermined FF7 input data area 4002 of identification data area 9a as an FF output value (activity data) Y of operation initial value next time. The FF output value (activity data) Y written in identification data area 9a is imprinted by identification data area 9b by the side of the standby system corresponding to the same address. moreover, TP7 by which the input data required for an operation is stored in timer TP7' by the predetermined work-piece data area in memory 8a if it becomes the operation period of timer TP7' in control operation program 6a -- ' -- while reading TP input data C from the input data area 4004 -- last time -- timer progress value Z' of an operation -- predetermined TP7' of identification data area 9a -- it reads from the output data area 4005, and data processing of a timer progress value is performed. if this data processing is completed -- timer TP7' by the side of a main system -- the result of an operation -- TP output-data Z -- carrying out -- predetermined TP7' in memory 8a -- at the same time it stores in the output data area 4006 -- TP7 of identification data area 9a predetermined [as a timer progress value (activity data) Z of operation initial value] next time -- ' -- it writes in the input data area 4005. The timer progress value (activity data) Z written in identification data area 9a is imprinted by identification data area 9b by the side of the standby system corresponding to the same address. Data flow between an arithmetic element, and a timer and memory, and data identification of both the controllers 1 and 2 is performed. Henceforth thus, the arithmetic element FF and

Timer TP of the main system controller 1 The FF output value Y required at the time of the data-processing activation for every period and the timer progress value Z are read from predetermined identification data area 9a. It calculates and the arithmetic element FF and Timer TP of the standby system controller 2 calculate by reading the FF output value Y imprinted by predetermined identification data area 9b prepared in memory 8b, and the timer progress value Z.

[0010] Drawing 4 shows the flow of internal-arithmetic processing of an arithmetic element. Here, it explains by making an arithmetic element FF 7 into an example, referring to drawing 3 . An arithmetic element FF 7 reads input data A and B from work-piece data areas other than identification data area 9a in memory 8a first (702). Next, it reads from identification data area 9a last time as a result of an operation (i.e., the last operation initial value Y') (703). Then, "1" and "0" are judged (704), and at the time of B= 1, the value of input data B sets the value of output-data Y to "0", and writes in the work-piece data area in memory 8a (705). At the time of B= 0, value"1" of input data A or "0" is judged (706), and at the time of A= 1, the value of output-data Y is set to "1", and it writes in the work-piece data area in memory 8a (707). Moreover, at the time of A= 0, the value of output-data Y is used as the output data of a front period, and it writes in the work-piece data area in memory 8a (708). Processings 704-708 of an arithmetic element FF 7 are performed, and the operation initial value of an operation is written in identification data area 9a by the side of a main system as an FF output value Y the result of an operation, i.e., next time, (709). In addition, the operation initial value of an operation is written in identification data area 9a by the side of a main system as a timer progress value Z by processing with the same said of Timer TP next time.
[0011] Drawing 5 shows the flow of identification processing of the main system controller 1. In drawing 5 , if the main system controller 1 becomes an identification processing period (501), these all data will be transmitted to the standby system controller 2 (502). Thus, in this example, it was made to perform identification processing of identification data area 9a from the main system controller 1 to the standby system controller 2 a fixed period.
[0012] Drawing 6 shows the flow of identification processing of the standby system controller 2. In drawing 6 , the standby system controller 2 resets the time counter for an identification data interruption monitor while storing these data in identification data area 9b of self, if identification data are received from the main system controller 1 (601) (602). On the other hand, from the main system controller 1, the standby system controller 2 will update the value of the time counter for an identification data interruption monitor, if there is no reception of identification data (603). Here, it has the relation of the before [value =] period time counted value + monitor period of the time counter for an identification data interruption monitor. Next, when the counted value of the time counter for an identification data interruption monitor is larger than the identification data interruption decision value N set up beforehand (604), it judges with the ability of identification of operation data to have not been performed between a main system / standby system controller, and a switch of a main system / standby system controller is forbidden (605). Although considered as the time when reception of the identification data from the main system controller 1 was not able to do the conditions which forbid a switch of a main system / standby system controller over time amount longer than the identification data interruption decision value N set up beforehand as for the standby system controller 2, in this example, you may decide as follows. That is, it is good also as time amount if the standby side controller 2 puts the conditions which forbid a switch of a main system / standby system controller in another way at the time of initial starting of a controller while the copy of an identification data area is not completed, until the copy of an identification data area will complete them. Moreover, it can also determine as time amount which obtains the maximum variation of the amount of processes which can permit the conditions which forbid a switch of a main system / standby system controller on the property of a process to the maximum working speed of the amount of processes of a controlled system. For example, in the controller which controls this fuel flow control valve for 40 seconds although it operates from 0% to 100%, if the opening command to this fuel flow control valve changes suddenly more than 20% (a fuel flow control valve is operates for 8 seconds at this thing.), the boiler operated with this fuel will carry out a flame failure, and the case of a control system which gives big trouble to a process will be considered. In such a case, although the data which should make it in agreement [between both controllers] are not in agreement since a fuel flow control valve cannot operate only a maximum of 17.5% in 7 seconds if the identification data interruption decision value N is set up with 7 seconds, even if a switch of a main system / standby system controller is performed, a problem does not become.
[0013] Thus, in order to determine beforehand the information which needs the identification of data for every control arithmetic element in this example among operation parameters, such as a timer TP setup used for the I/O signal of the arithmetic element FF in a control circuit, and the operation of the arithmetic element, The information which needs the identification which writes this in identification data area 9a, and is transmitted from a main system side in a standby system side at a main system side only by imprinting to identification data area 9b The need for the selection which identification of the data of both the controllers 1 and 2 is attained, therefore is done by the designer each time is lost,

and the dependability of a control unit improves. Moreover, between both the controllers 1 and 2, since the data which need identification are periodically copied to the identification data area of the main system controller 1 to the standby system controller 2, there is no need for the time amount for carrying out identification of this data at the time of a switch of the main system / standby system of a controller, and they can raise the continuity of the process control at the time of a controller switch at it. Moreover, even if the result of an operation of both the controllers 1 and 2 of the control operation programs 6a and 6b corresponds and a switch of a main system / standby system controller occurs at the time of arbitration, process control which change did not occur suddenly in the process I/O of a controller, and was stabilized is performed. Moreover, when not performing in the standby side controller 2 beyond the time amount that the copy of an identification data area set up beforehand, Or when the copy of an identification data area is not completed by the standby side controller 2 at the time of initial starting of a controller, Or while the amount of processes of a controlled system is changing, when identification of data is not performed more than over the time amount part which obtains the maximum variation of the amount of processes permissible on the property of a process All write a main system / standby system controller switch as it is improper, while the data which need data coincidence have been an inequality between both the controllers 1 and 2, a switch of a main system / standby system is not performed, but it can prevent causing turbulence in a plant.

[0014]

[Effect of the Invention] As explained above, in order to determine beforehand the data which need identification between a main system controller and a standby system controller for every control arithmetic element according to this invention, The data which write this data in an identification data area in a main system side, and are transmitted from a main system side in a standby system side only by imprinting to an identification data area Since identification of the data of both controllers is attained, there is no need for the selection done by the designer each time, and the group people elements on a control unit design can decrease in number, and improvement in dependability can be aimed at with improvement in the quality of a control unit. Moreover, since the data which need identification are periodically copied to the identification data area of a main system controller to a standby system controller, there is no need for the time amount for carrying out identification of this data at the time of a switch of the main system / standby system of a controller, and they can raise the continuity of the process control at the time of a controller switch at it. Moreover, the result of an operation of a control operation program can perform process control which change did not occur suddenly in the process I/O of a controller, and was stabilized, even if both controllers are in agreement and a switch of a main system / standby system controller occurs at the time of arbitration. Moreover, since it was made not to perform a switch of a main system / standby system at the time of a main system / standby system controller switch while the data which need data coincidence had been an inequality among both controllers, it can prevent causing turbulence in a plant and the stability of process control can be raised.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram of the multiplex system of the control unit in which one example of this invention is shown
[Drawing 2] The conceptual diagram explaining the data identification in both the controllers of this invention
[Drawing 3] Detail drawing showing the data flow by the data identification shown in drawing 2
[Drawing 4] The flow Fig. of internal-arithmetic processing of the arithmetic element in this invention
[Drawing 5] The flow Fig. of identification processing of the main system controller in this invention
[Drawing 6] The flow Fig. of identification processing of the standby system controller in this invention
[Description of Notations]
1 Main System Controller
2 It is Controller Standby Side (System).
3 Network
4 System Bus
5 Process I/O Unit (PI/O)
6a, 6b Control operation program
7a, 7b Arithmetic element
8a, 8b Memory
9a, 9b Identification data area

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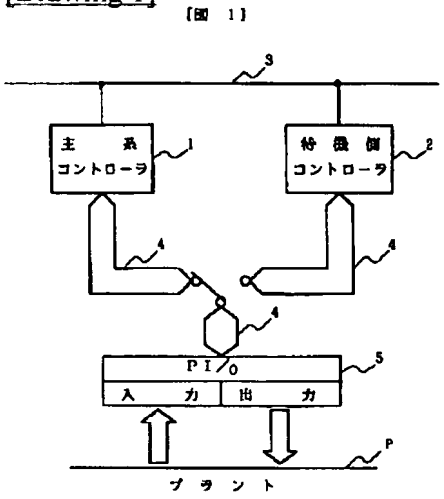
DRAWINGS

[Drawing 1]



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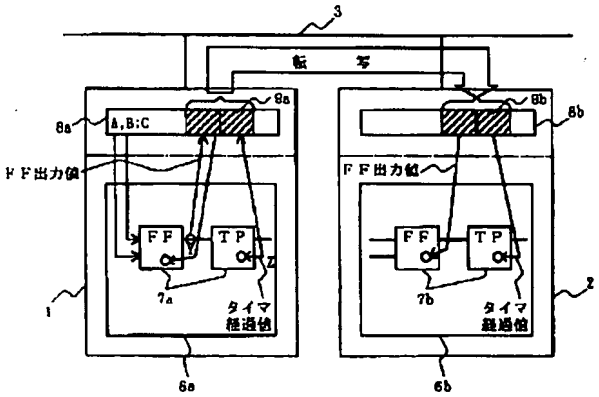
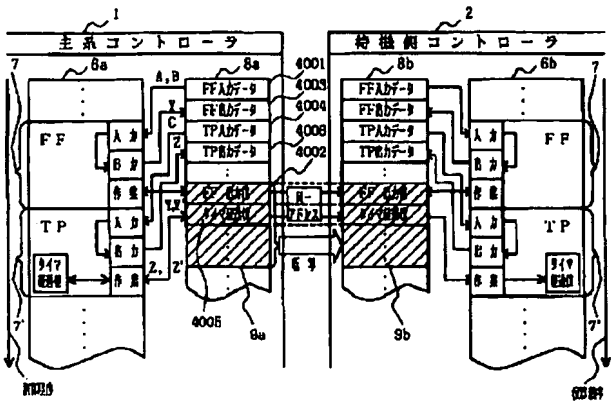


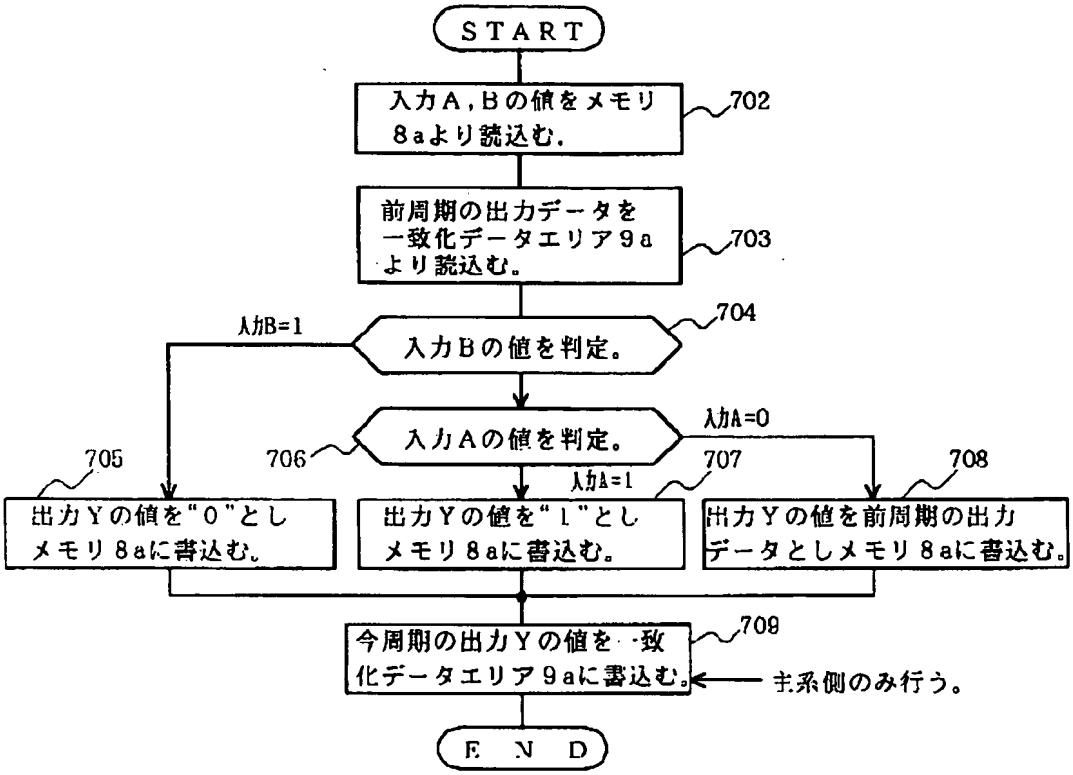
[Drawing 3]

【図 3】



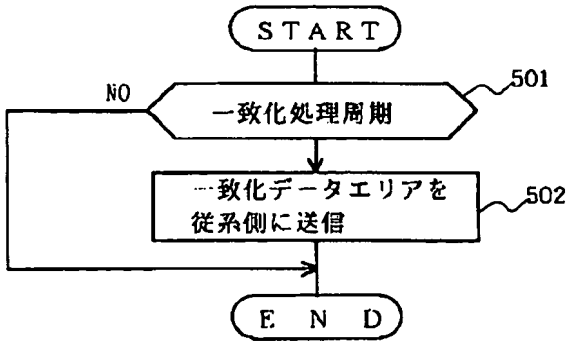
[Drawing 4]

【図 4】



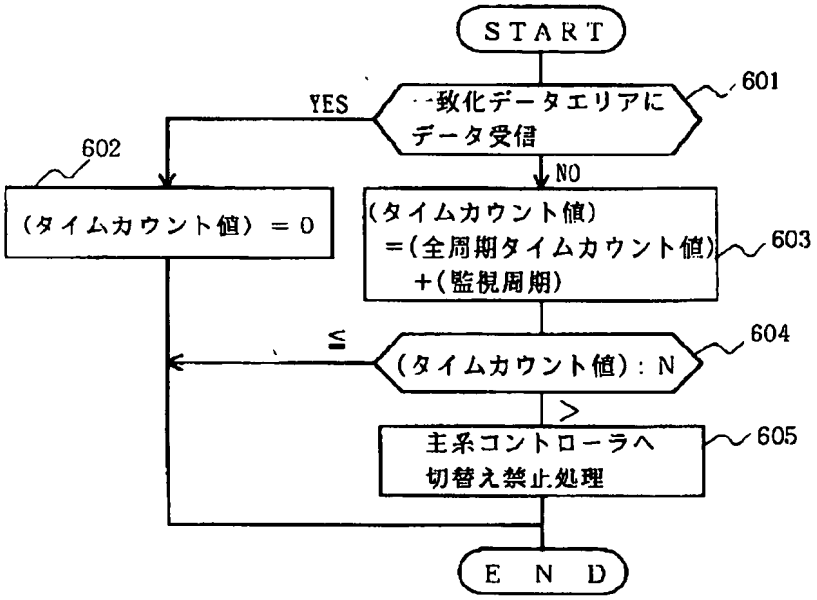
[Drawing 5]

【図 5】



[Drawing 6]

【図 6】



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